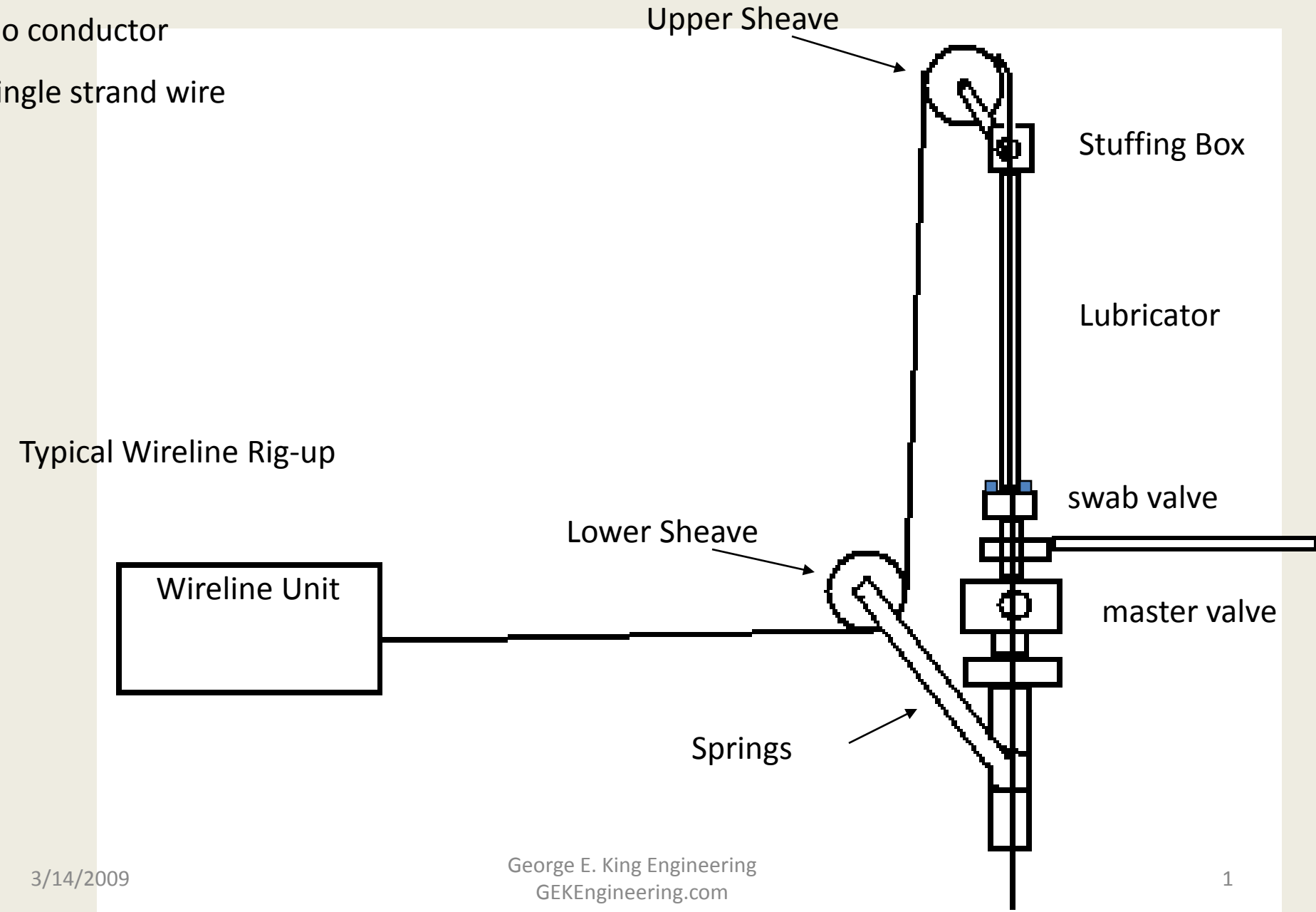
Slickline

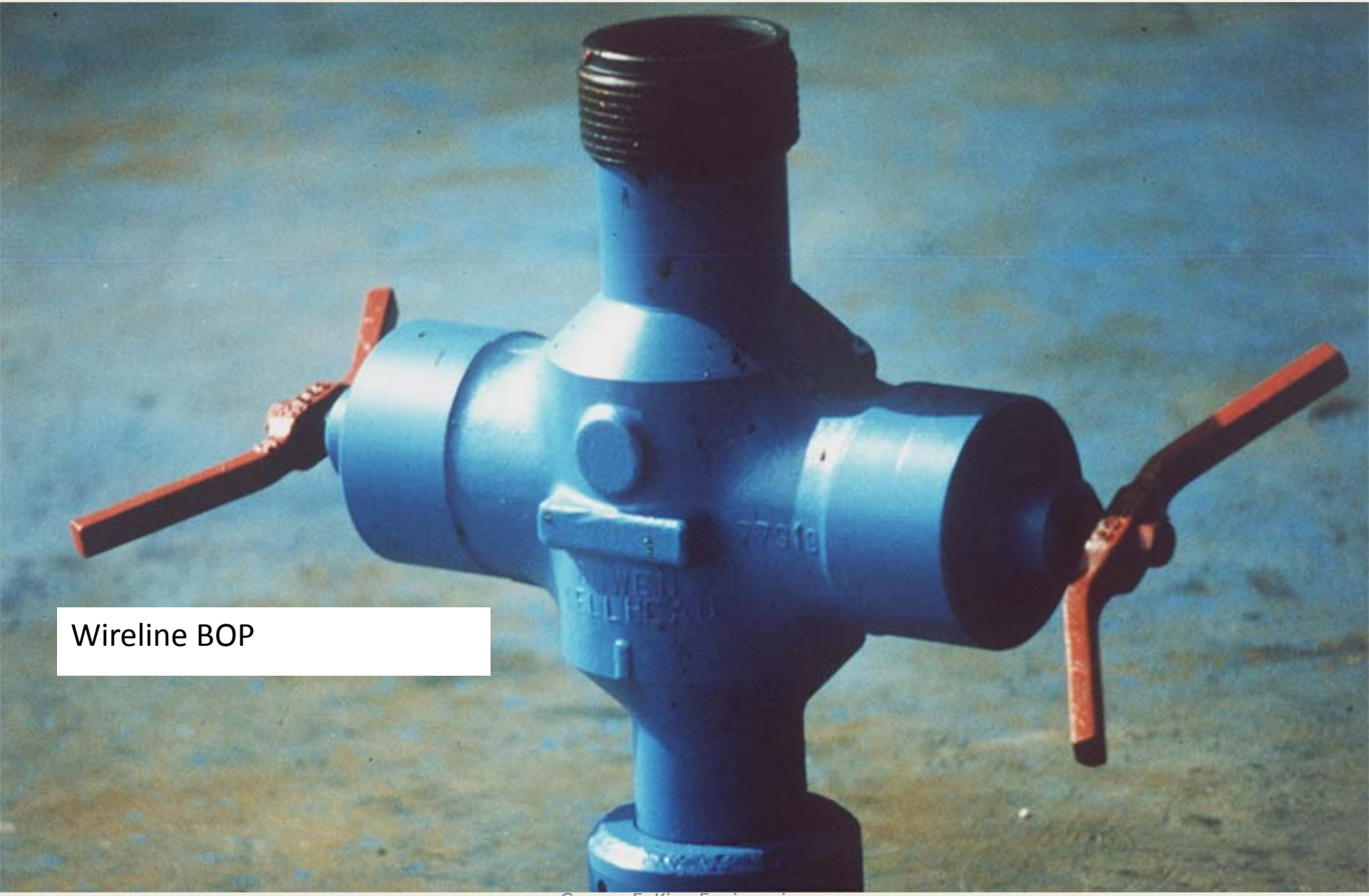
- No conductor
- Single strand wire



ASEP
SmartMonitor
ON
RESET
OFF
LBS
Tension [lbs]
LandLine
LEVELWIND CTRL
DOWN
UP
WIRE SPRAY
ON
OFF

Wireline Surface Equipment

- Reels and Controls
- BOP
- Lubricators
- Grease (oil) Seals



Wireline BOP

Lubricator Layout and Loading – wireline operations

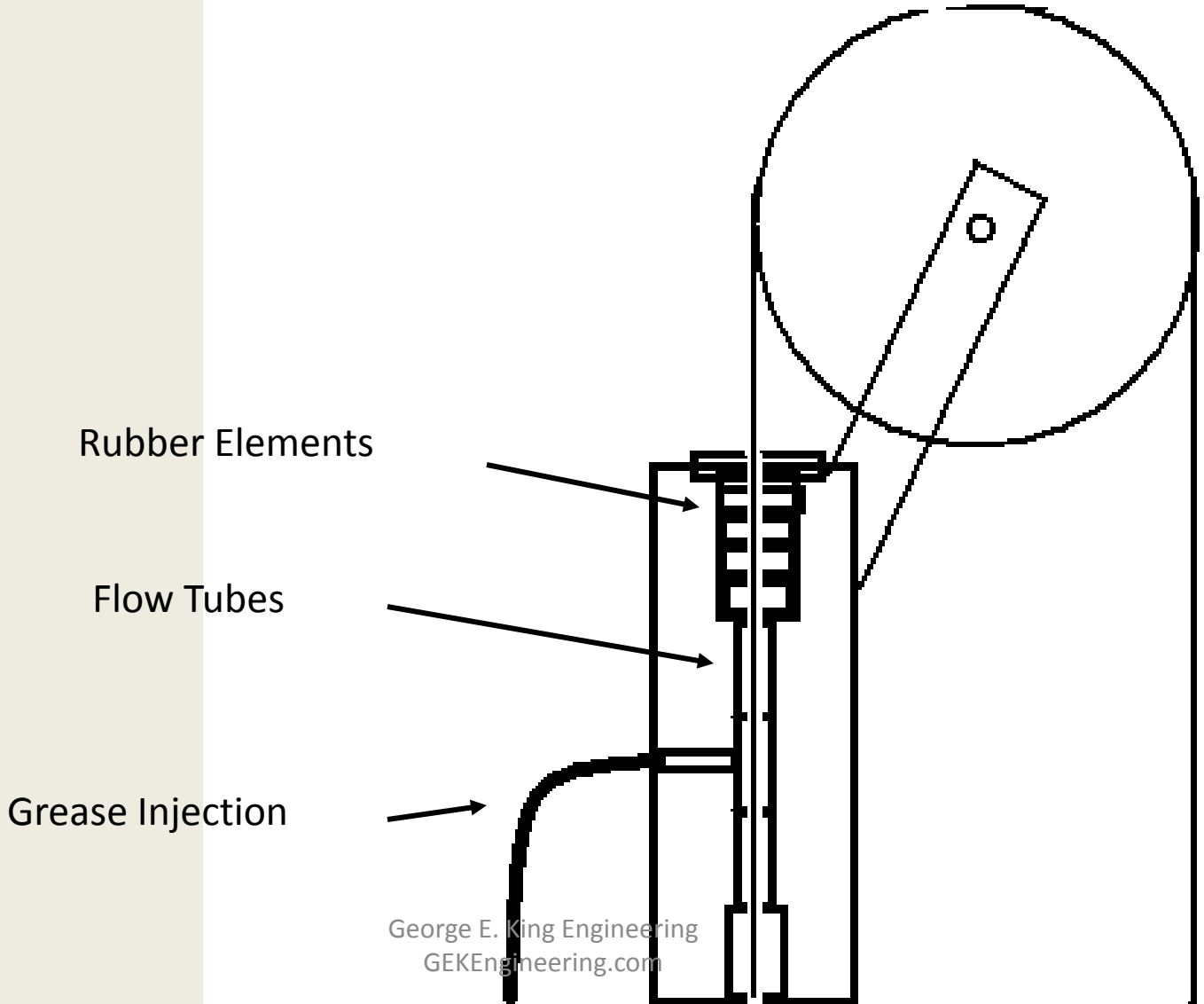
Lubricator Length

- "Consider the tool string length when sizing the lubricator length. The available length to swallow a tool string is from the top of the swab valve to the bottom of the flowtubes. This length should be the TOTAL tool length, line head to bottom nose, plus 3 extra feet."

Stuffing Box – the Main Seal on the Wire

- Braided Line – Grease Injector
- Slick Line - Rubber elements with and without oil injection capacity. A hydraulic oil is usually used for sealing and lubrication of the wire.

Schematic of a Grease Injector for Braided Line



Braided Line Grease Injector

- **Blowing grease in the air? - the rubber is worn out.**
- **Loosing grease in the well? -flow tubes too big/worn, braided line worn. Either way, too much clearance.**
- **Number of tubes depends on the pressure. Bottom flow tube must be close to diameter of braided line.**
- **If grease use is high (over 10 lb/day) operator may be pumping too much grease - more than needed.**
- **Greases comes in different viscosities, formulated for pressure and temperature combinations .**
- **If hanging gauges in well on braided cable during a job, do not pump grease - just tighten rubbers.**
- **Some greases thicken and/or emulsify with well or injected fluids. Formation damage can be severe.**

Wireline Fishing/Jarring Best Practices

- Maximum fishing time of 45 minutes to 1 hour before reheading wire – move the fatigue point (fatigue caused by continual working over the shieves during jarring) – usually cut off 100 ft.
- Work to 50% of max load.
- Use of 0.125 and braided wire considered?

Some Wire Types

- Bright Steel – most widely used, not for H_2S or CO_2
- AISI 304 – H_2S service
- AISI 316 - H_2S service

Wire Limits (Bright Steel) (estimates only)

Wire Size	Minimum Tensile Strength	MaximumWork Level
0.072”	972 lb.	500 to 600 lb. ?
0.082”	1239 lb.	850 lb. ?
0.092”	1547 lb.	1000 lb. ?
0.108”	2436	1400 lb. ?
0.125”	3200	1800 lb. ?

Minimum tensile is 75% of rated break strength.

Data for “bright plow steel wire”

Wire Limits - AISI 304 (estimates only)

Wire Size	Minimum Tensile Strength	MaximumWork Level
0.082”	1280 lb.	850 lb. ?
0.092”	1582 lb.	1000 lb. ?
0.105”	2070 lb.	1400 lb. ?

Minimum tensile is 75% of rated break strength.

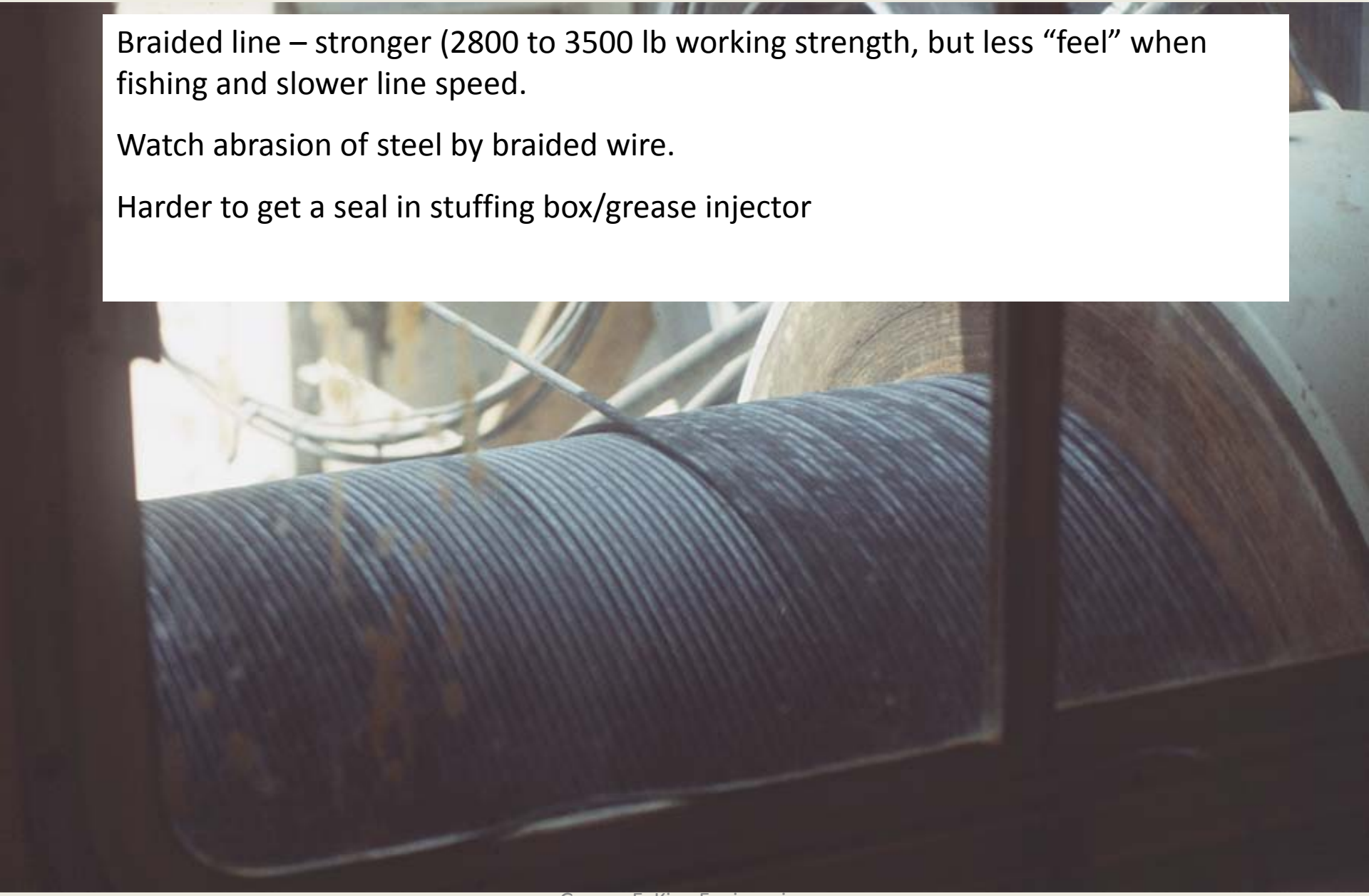
Wireline breaks involve fatigue, physical damage to the wire, corrosion and other factors.

Nominal Weight of Wire

Wire Size	Wt per 1000 ft of wire
0.072	14 lb
0.082	18 lb
0.092	22.6 lb
0.108	31 lb
0.125	44 lb

Selecting Wireline

- What devices have to be pulled (weights, loads)?
- What impact forces are needed?
- What are the tubing sizes?
  - Small tubing – smaller wire, easier to work and recover.
- Corrosion potential?
- Local preferences?



Braided line – stronger (2800 to 3500 lb working strength, but less “feel” when fishing and slower line speed.

Watch abrasion of steel by braided wire.

Harder to get a seal in stuffing box/grease injector

Wireline Operations

- Common workovers with wireline
  - liquid and fill tags
  - gauge running and retrieval
  - gas lift valve replacement
  - sleeve shifting
  - plug and packer setting
  - bailer runs

Wireline Operations

- Advantages - speed, cost, footprint, “feel”
- Disadvantages
  - **low wire strength**
  - **lack of rotation**
  - **lack of circulation**
- Problems
  - **lack of experienced operator**
  - **poorly maintained units**
  - **impatience**
  - **poor well records**

Common Problems with Wireline

- Wire breaks
  - Fatigue (work hardening failure)
  - corrosion (H_2S, CO_2, acids)
  - load failure
- Damage to well equipment and coatings from wire abrasion

Slick Line Torsion Tester - Twist testing has eliminated wire breakage in many areas.

Wire Fatigue – Number of turns to break wire

Wire Size	New	Min turns to break
0.072		29
0.082		26
0.092		23
0.108		20
0.125	22	18

Look at the type of break

- Smooth – no problem
- Jagged – embrittlement possible, even if the turn count is within minimum tolerance, put new wire on the unit.
  - Corrosion by H_2S and CO_2
  - Fatigue mixed with embrittlement

Wireline Fatigue

- Limit the wireline crews to 50 - 60 jar cycles prior to POOH and cut of +/- 50m wire

Some Very Basic Learnings

- About “90%” of success is in the operator selection.
- Wire line breaks can be almost totally eliminated by torsion testing of wire and limiting jarring times.
- When wire breaks, always expect a little wire above the rope socket.
- When possible, run a fishing tool that has a release.
- H_2S wells can be wireline nightmares

Wireline Equipment Checks

- 1. Measure and record data for all equipment that goes in the hole.
  - diameters of every component
  - tool body lengths
  - thread patterns of each component
  - Tapers, shoulders, unusual equipment
  - compressed and extended jar lengths

Wireline Equipment Checks

- 2. Wire history
  - size, material
  - use history
  - corrosion treatment
  - torsion testing (turns before breaking)
  - jarring time in one spot (working continuously over the shieve or pulley thins and fatigues wire)

Wireline Equipment Checks

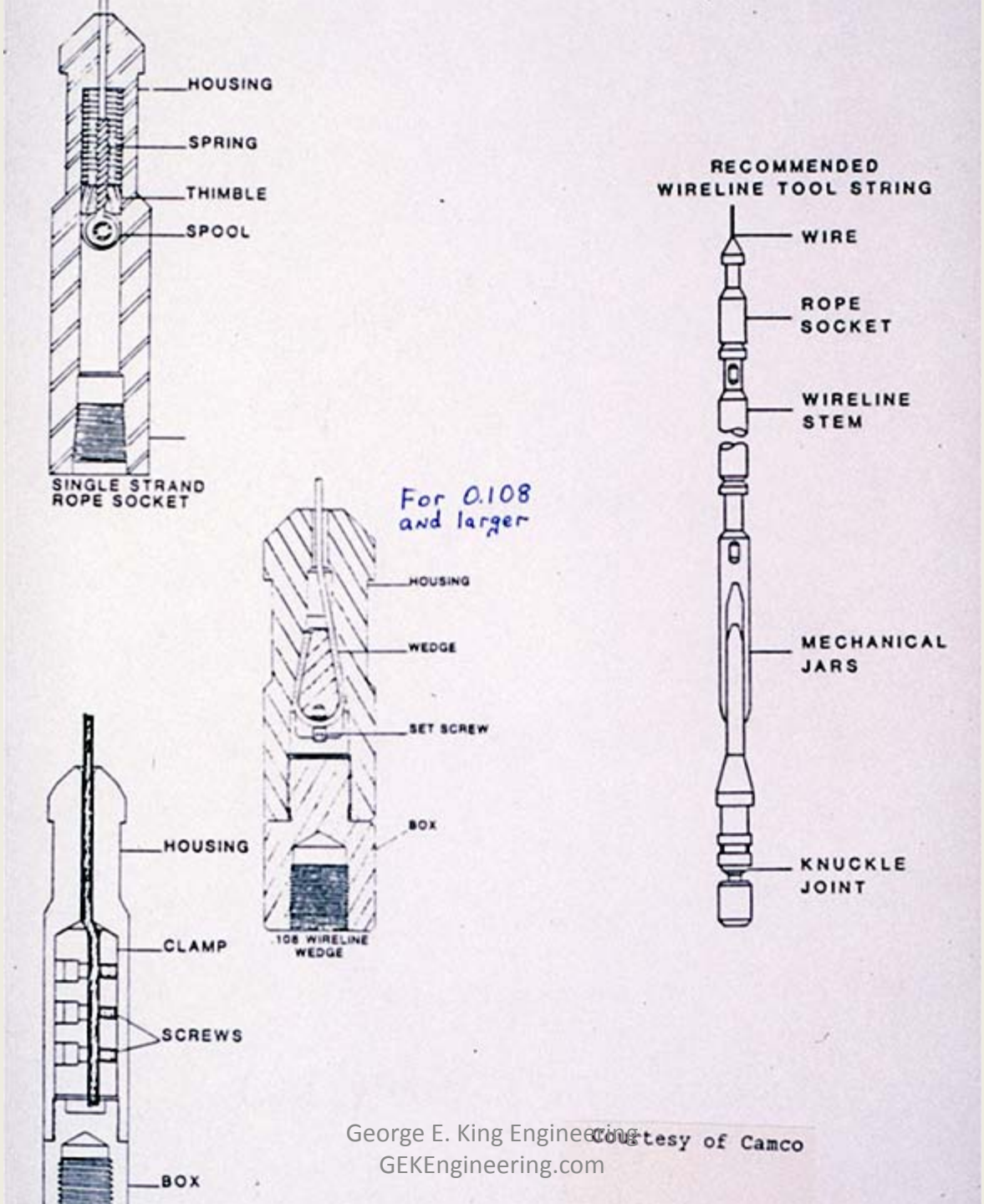
- 3. Equipment
  - working condition
  - support for loads
  - lubricator pressure limit
  - seal equipment capability and backup
  - seal equipment sizing

0.125” Wireline

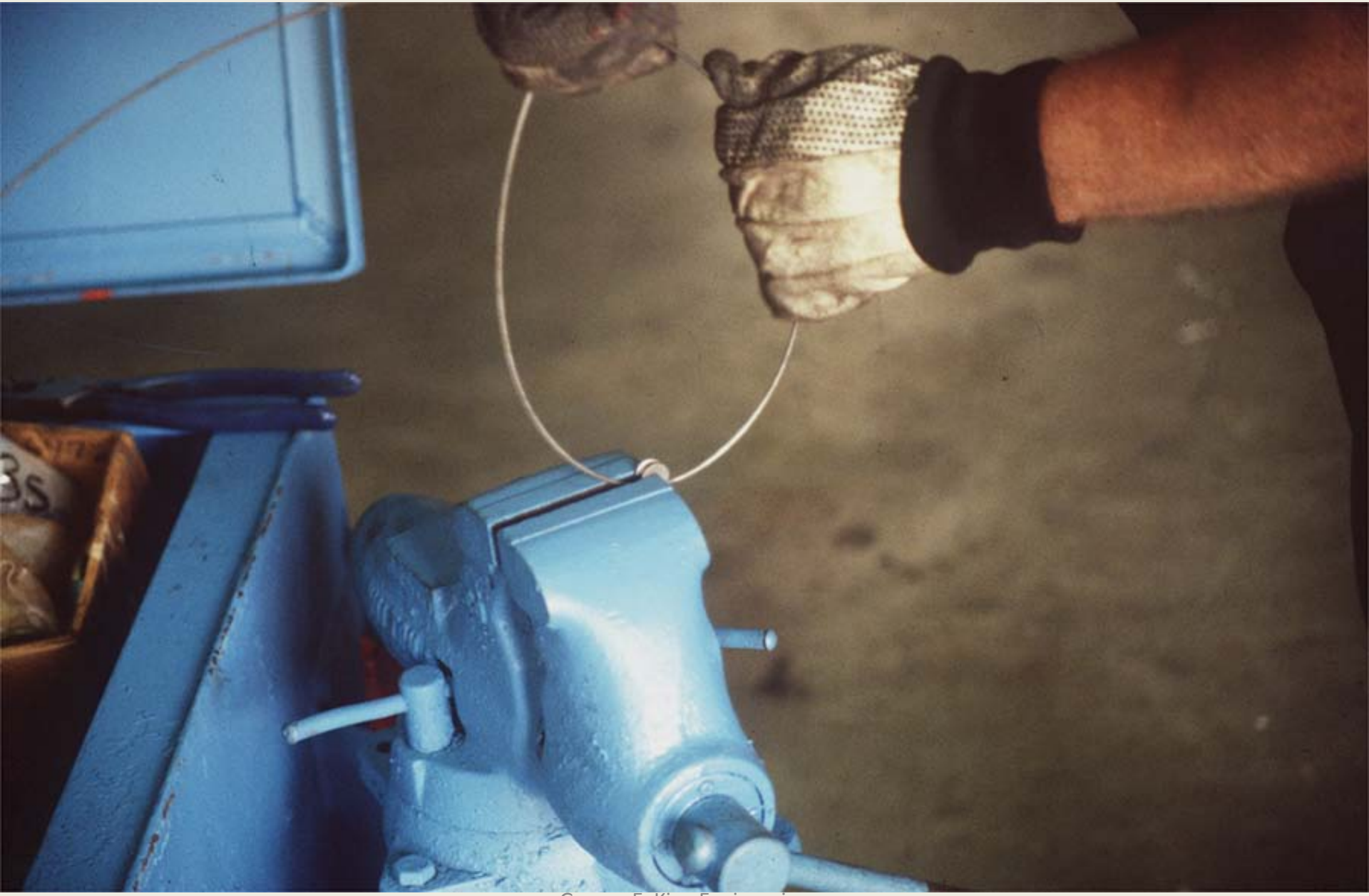
- extra pulling cap. advantage, w/stubborn SSSV's
- need 16" shieves and winch, tools etc., to match
- more muscle required to make the rope socket
- when fishing, it tends to come out in 2-10' lengths.
- consider use of sidewall cutters, box off wire if break
- main hurdle is education of the operators
- extra weight when deep cancels out extra pulling cap.
- less "feel", less accelaration when jarring

Wireline Basic Equipment

- Rope Socket
- Jars
- Tools
- Wireline torsion testers



Courtesy of Camco



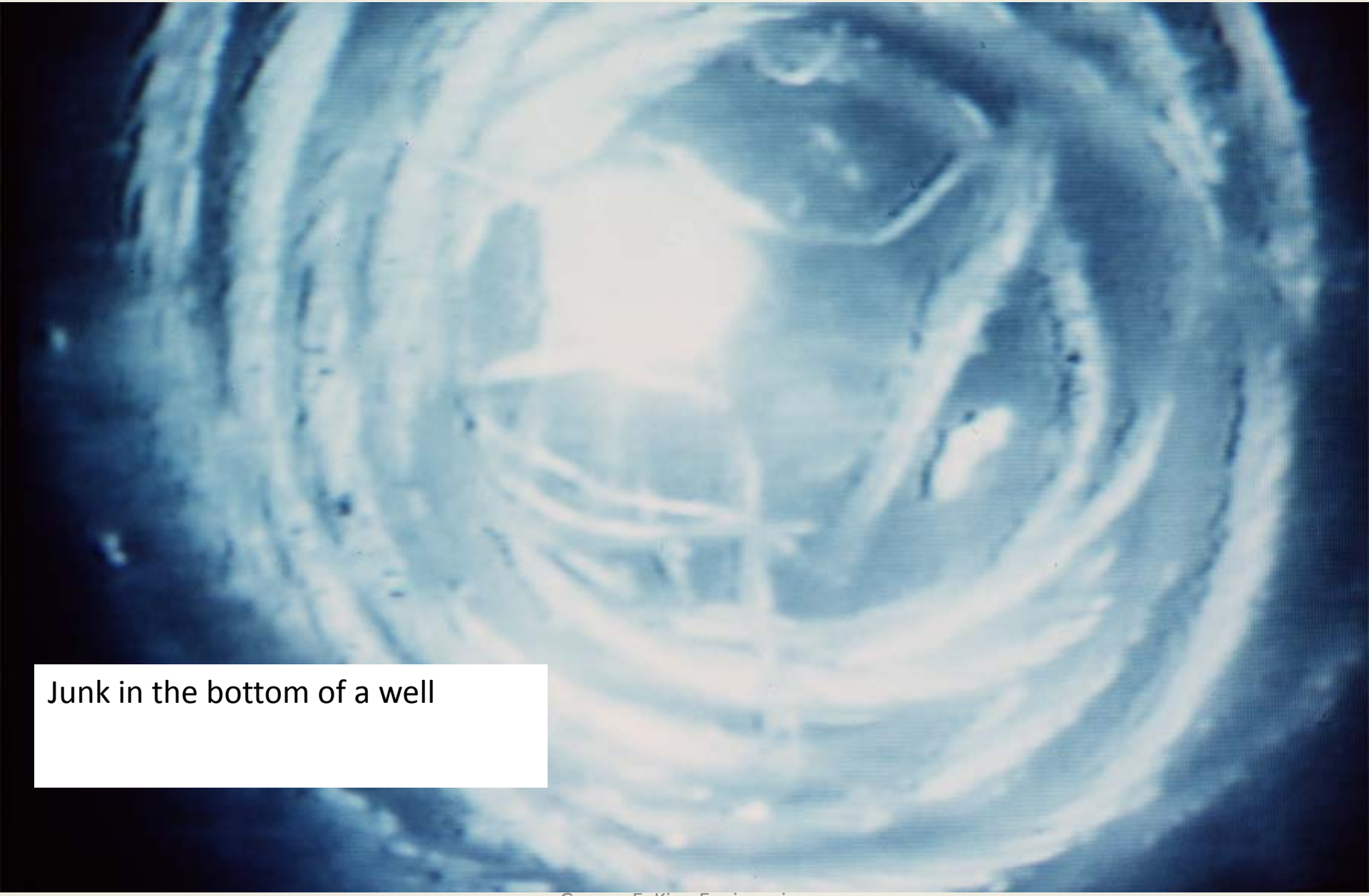
There are many different types of rope rockets.

The number of turns in the wire influences breaking strength.

If wire breaks prematurely during rope sock makeup , do a torsion test.

Wire Cutter Problems in Deviated Wells

- When the tool string is stuck, the most common approach is to cut the wire as close to the BHA as possible with a drop-type cutter.
- In high angle wells there is potential for a traditional wire cutter not to get to bottom.
- Need for a releasable rope socket?

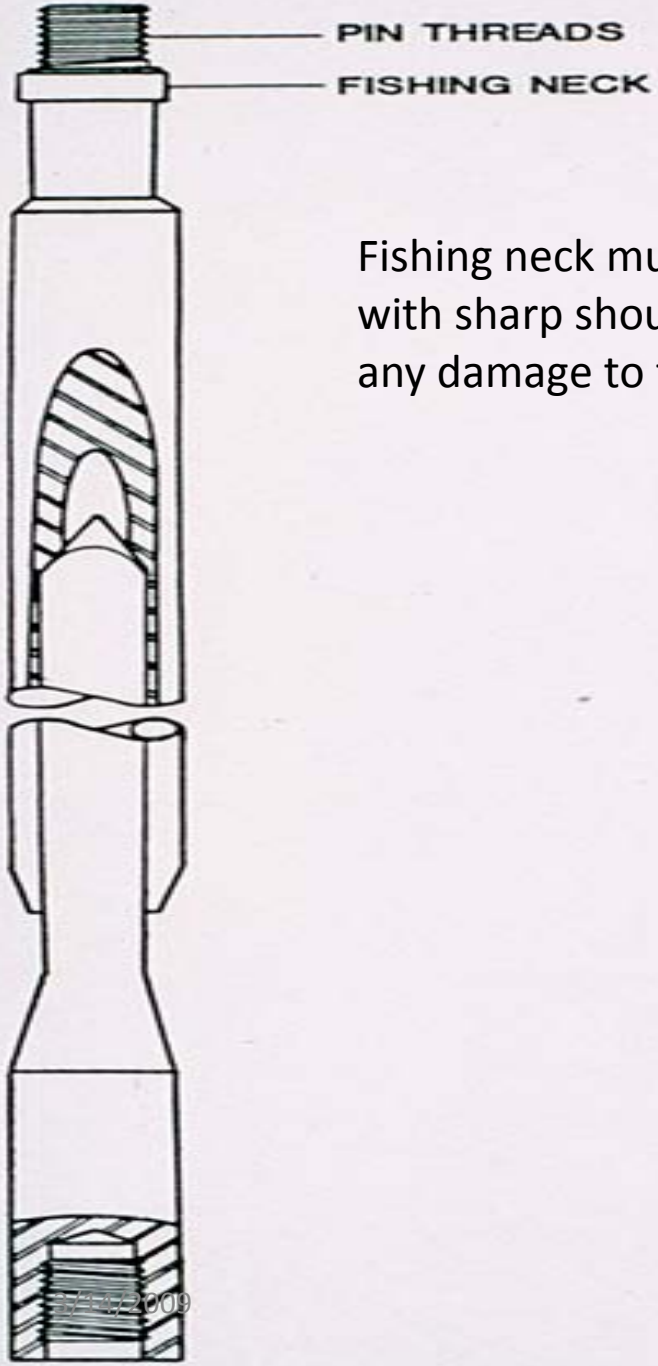


Junk in the bottom of a well

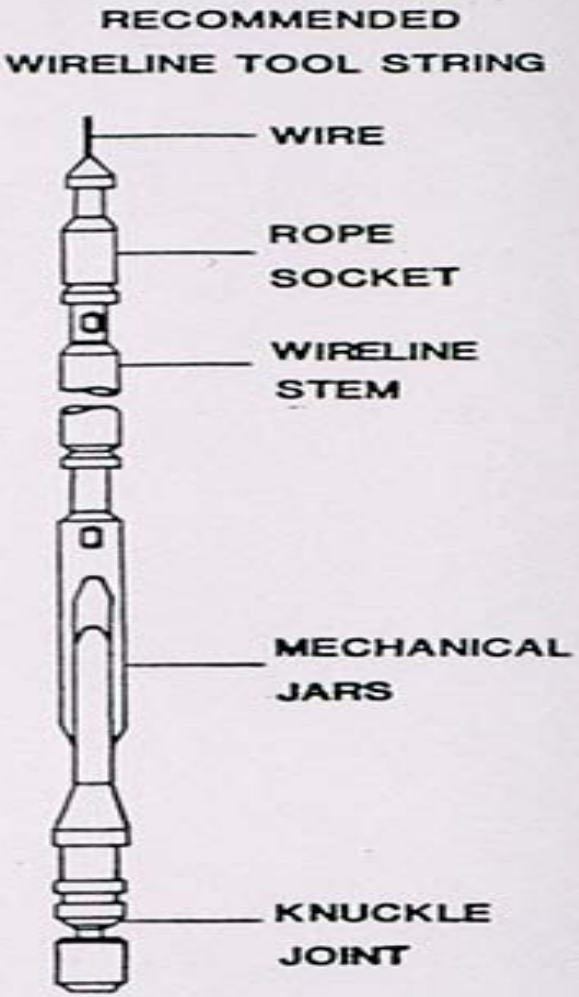
Jars

- Mechanical or spang jars – old design, but very effective
  - Mostly for near vertical wells, but have been used in deviated sections (losese effectiveness as deviation increases)
- Hydraulic jars
  - Much slower acting
  - Less (?) affected by deviation – still requires a tight wire above the jar.

WELL-CO
OIL SERVICE, INC.



Fishing neck must be in good shape with sharp shoulders. Also, look for any damage to threads.



Courtesy of Camco

Hydraulic Jars

- **Hydraulic Jars – initial problems.**
  - ***Problematic operation in gas & hot wells.***
  - ***Minimal impact forces due to short stroke length.***

- **Spring Jars were developed with longer stroke leading to greater impact forces.**
  - ***Fixed spring value - jar had to be disassembled to change.***
  - ***Typically only 3 different values of spring available.***

- **Adjustable Upstroke Jar (PAJ) (Petroline- Weatherford)**
  - ***Longer stroke leading to greater impact forces.***
  - ***Jar setting can be changed across a wide range and without disassembly.***
  - ***Disc spring stack design a highly efficient stored energy medium.***

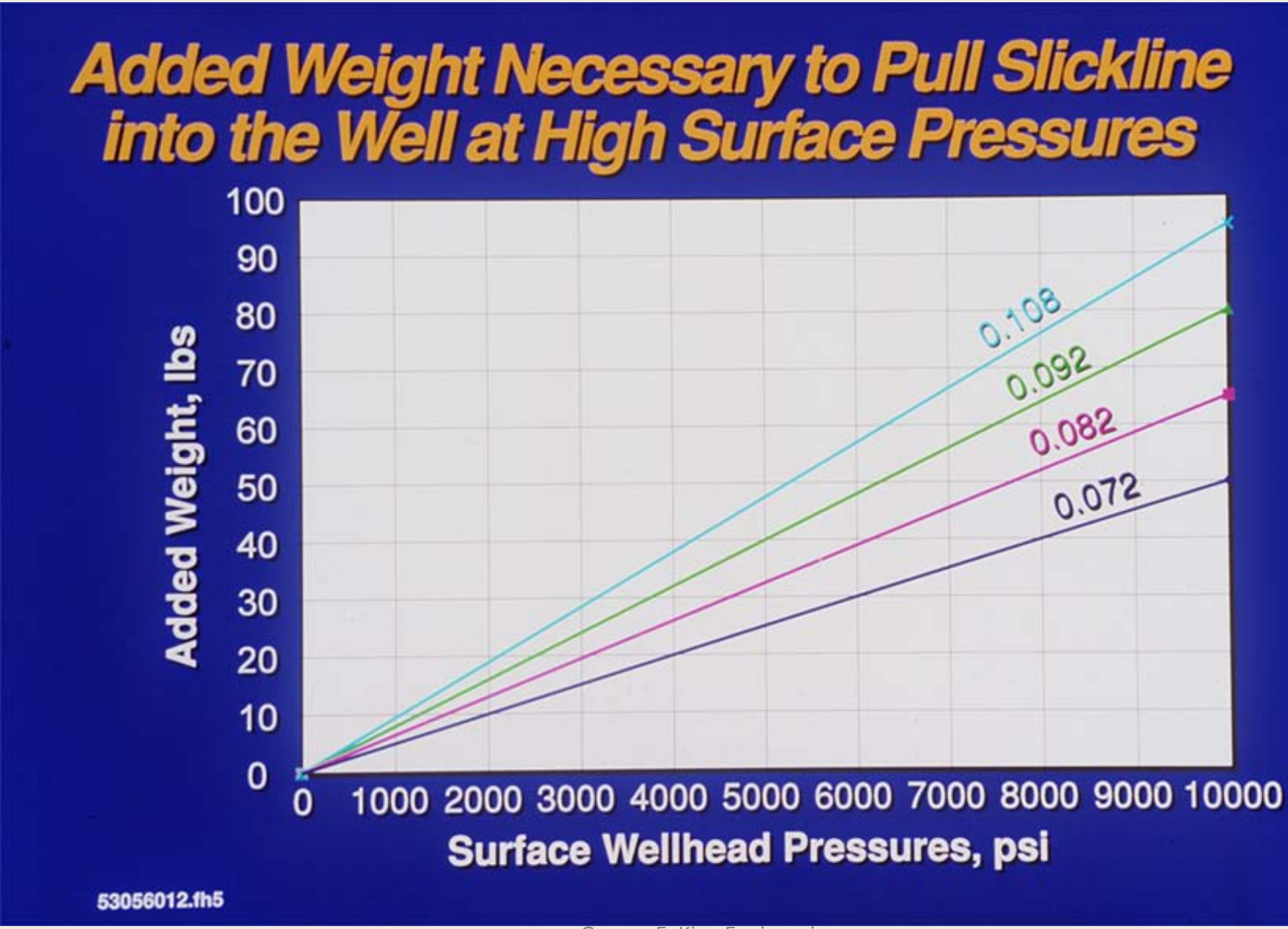
Tools

- Basic Tool String Design
- Running Tools
- Fishing Tools

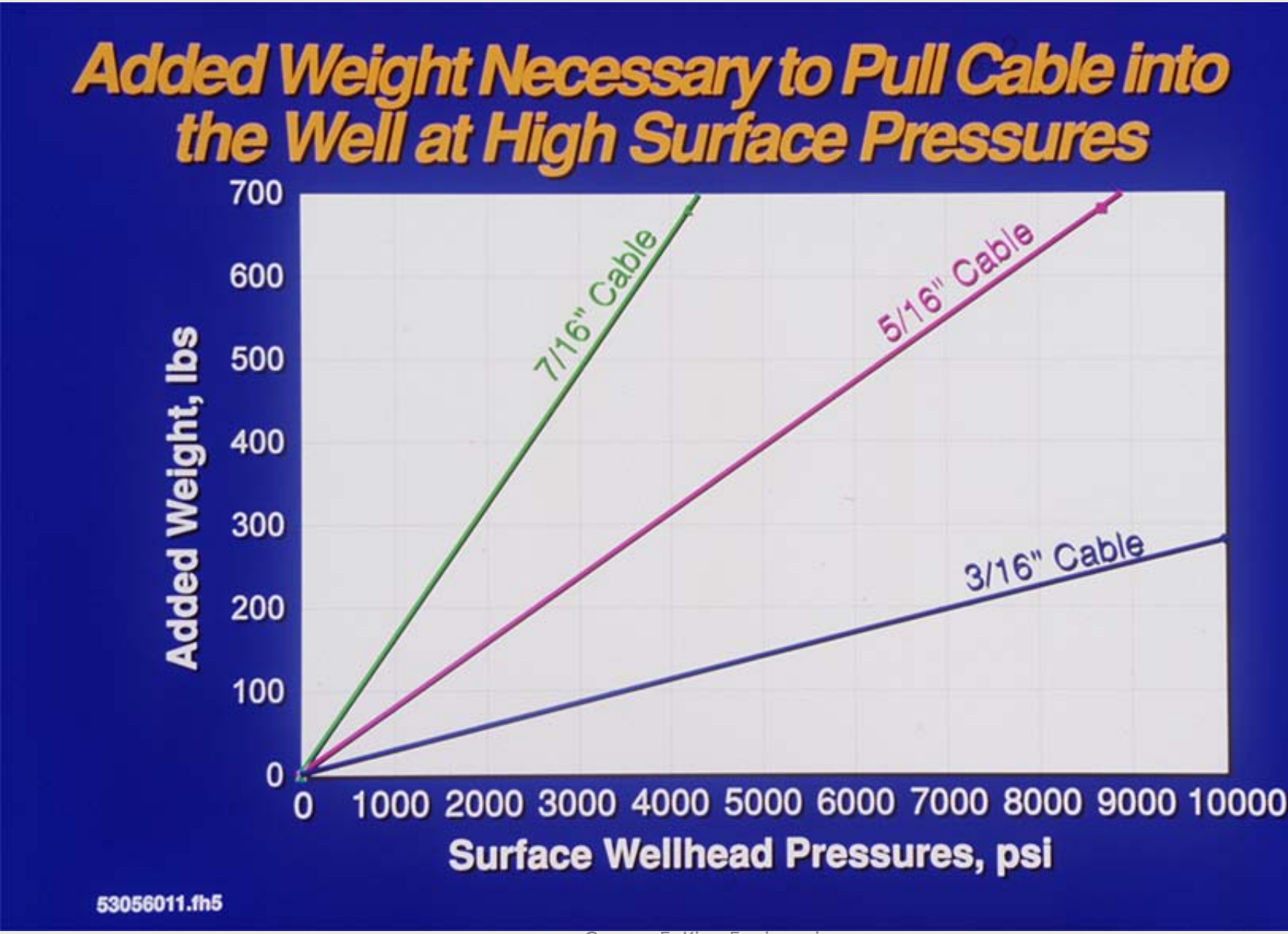
Pulling Weight Into the Well – The Problems

- Long lubricators required
- Rig up height increased
- Added friction in deviated wells from longer weight stem
- Less wireline load capacity

Added Weight Necessary to Pull Slickline into the Well at High Surface Pressures

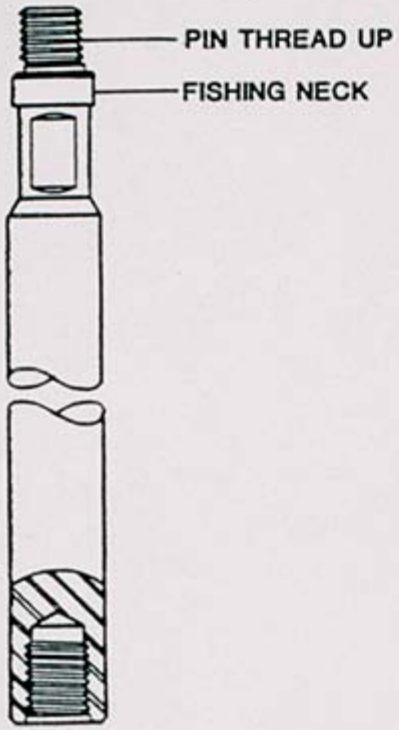


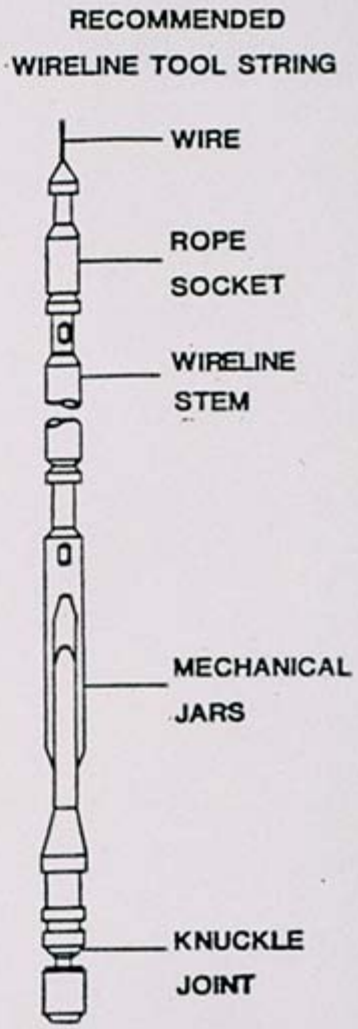
Added Weight Necessary to Pull Cable into the Well at High Surface Pressures



Tools

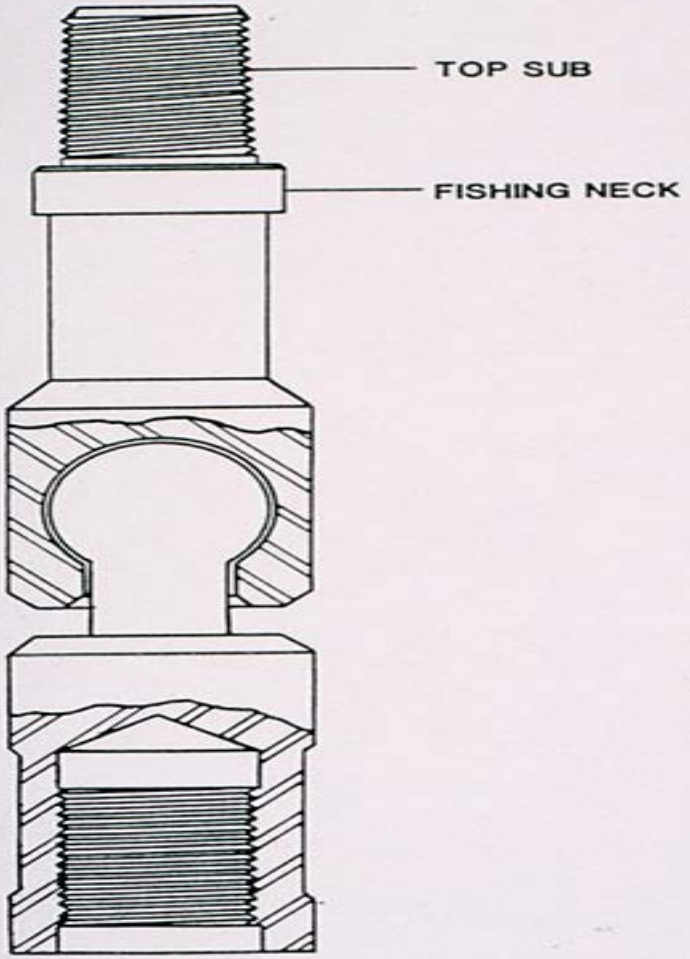
- Stem
- Knuckles
- Various Tools



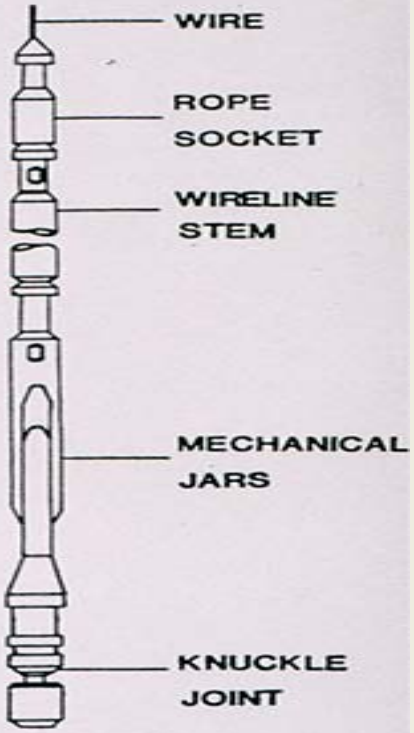


Courtesy of Camco

KNUCKLE JOINT



RECOMMENDED
WIRELINE TOOL STRING

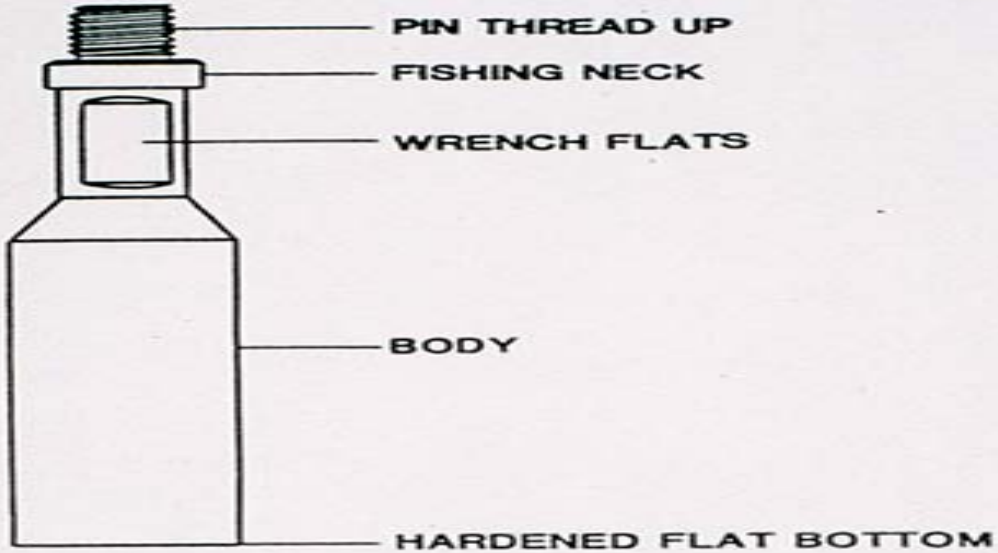


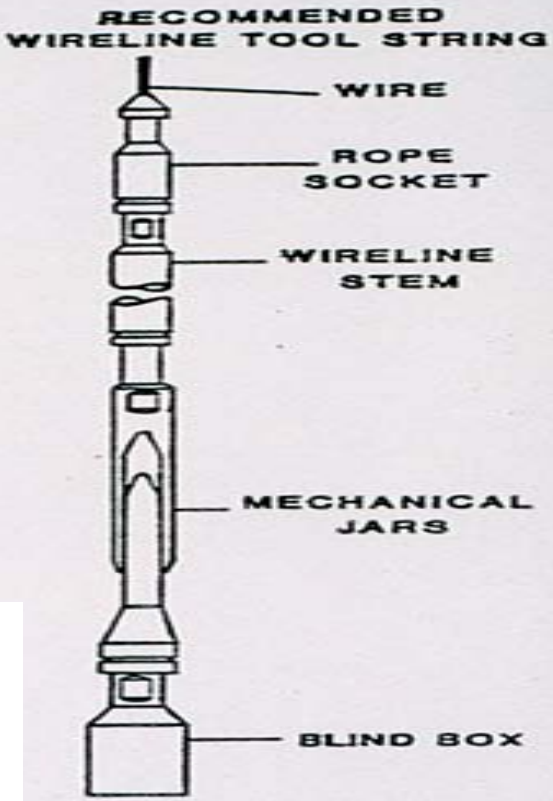
Courtesy of Camco

Gauge ring cutters

Problems in highly deviated wells - sticking

BLIND BOX





Dimension should closely follow id of tube - this allows check for partial collapse and prevents material from getting on top of tool string.

Camco

CT Fishing Survey Tools

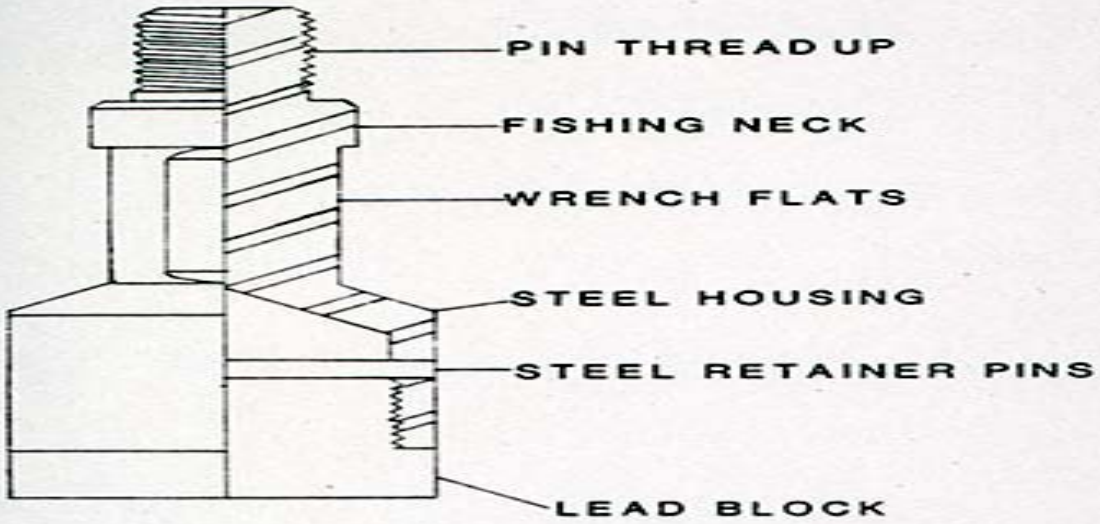
Tools and devices which help determine fish type and orientation

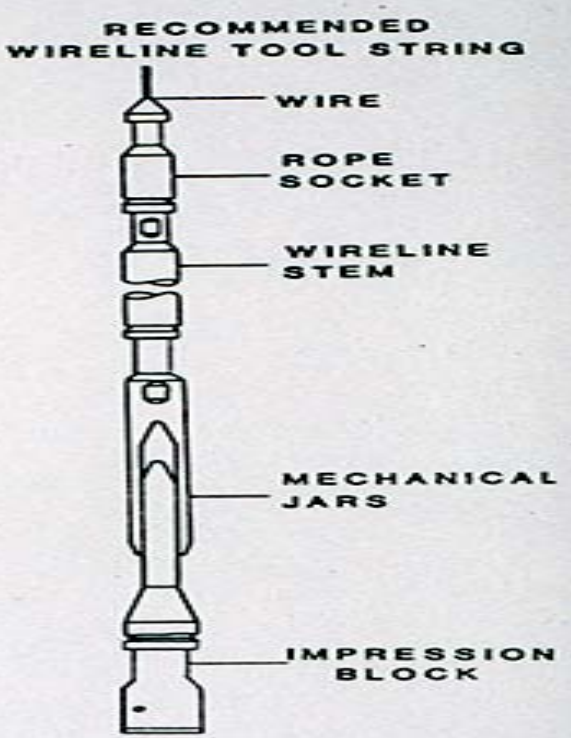
Lead impression blocks:

- Provide information on profile and orientation of the fish
- Experience required to interpret recovered impression

Downhole cameras transmit images/video to surface:

- Clean wellbore fluid required
- Temperature/time limitations
- High cost of service



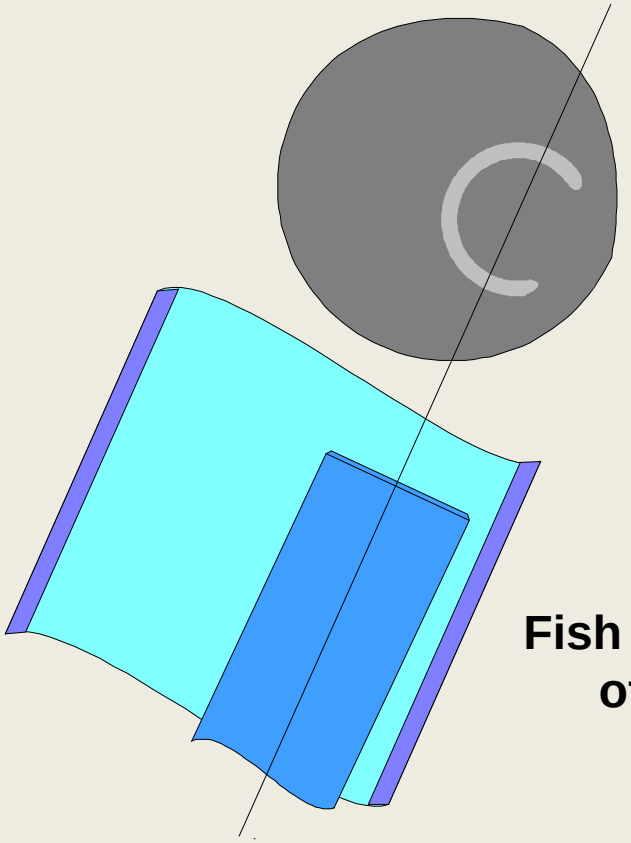


Courtesy of Camco

Set down once and retrieve. Multiple set downs only confuse the imprint.

Also known as a “confusion block” - generally for good reason.

Lead Impression Block Interpretation



Offset and incomplete impression

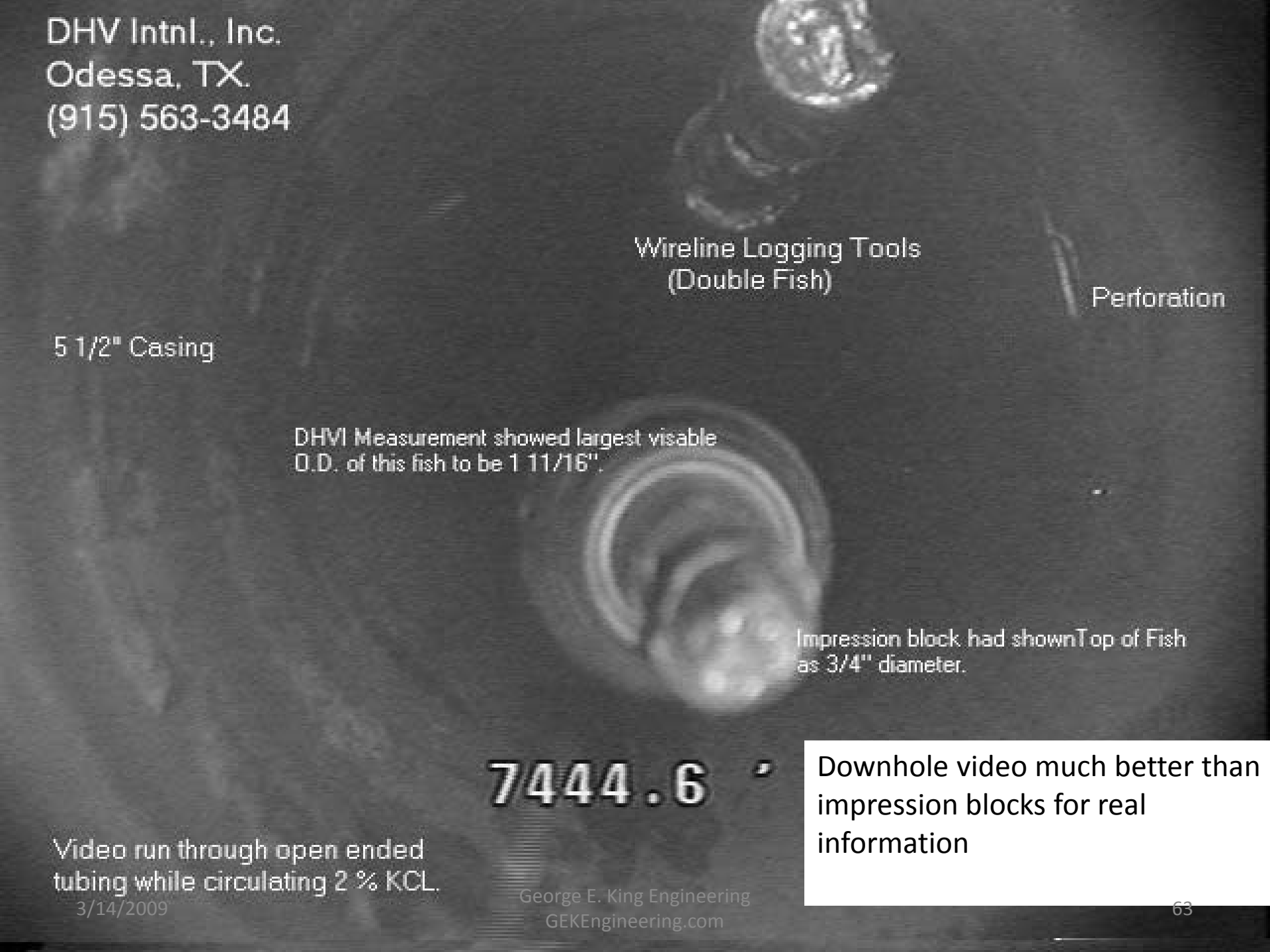
Fish lying on side of wellbore

5
4
2
in
ft
25ft
STANLEY
Life Guard

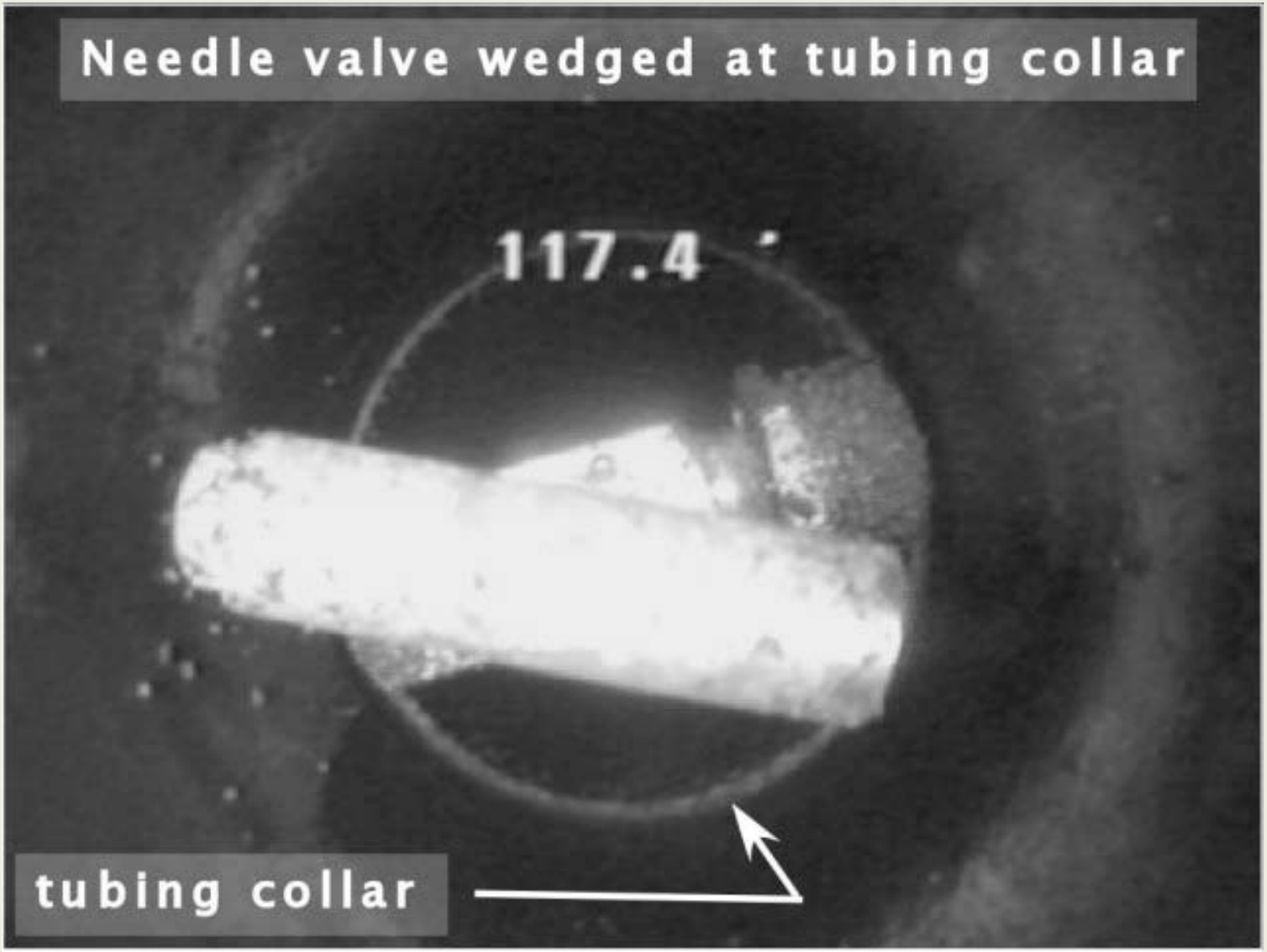
Some lead impression blocks may be made in various shapes for assistance in describing shapes or locations of fish.

Impression Block Best Practices

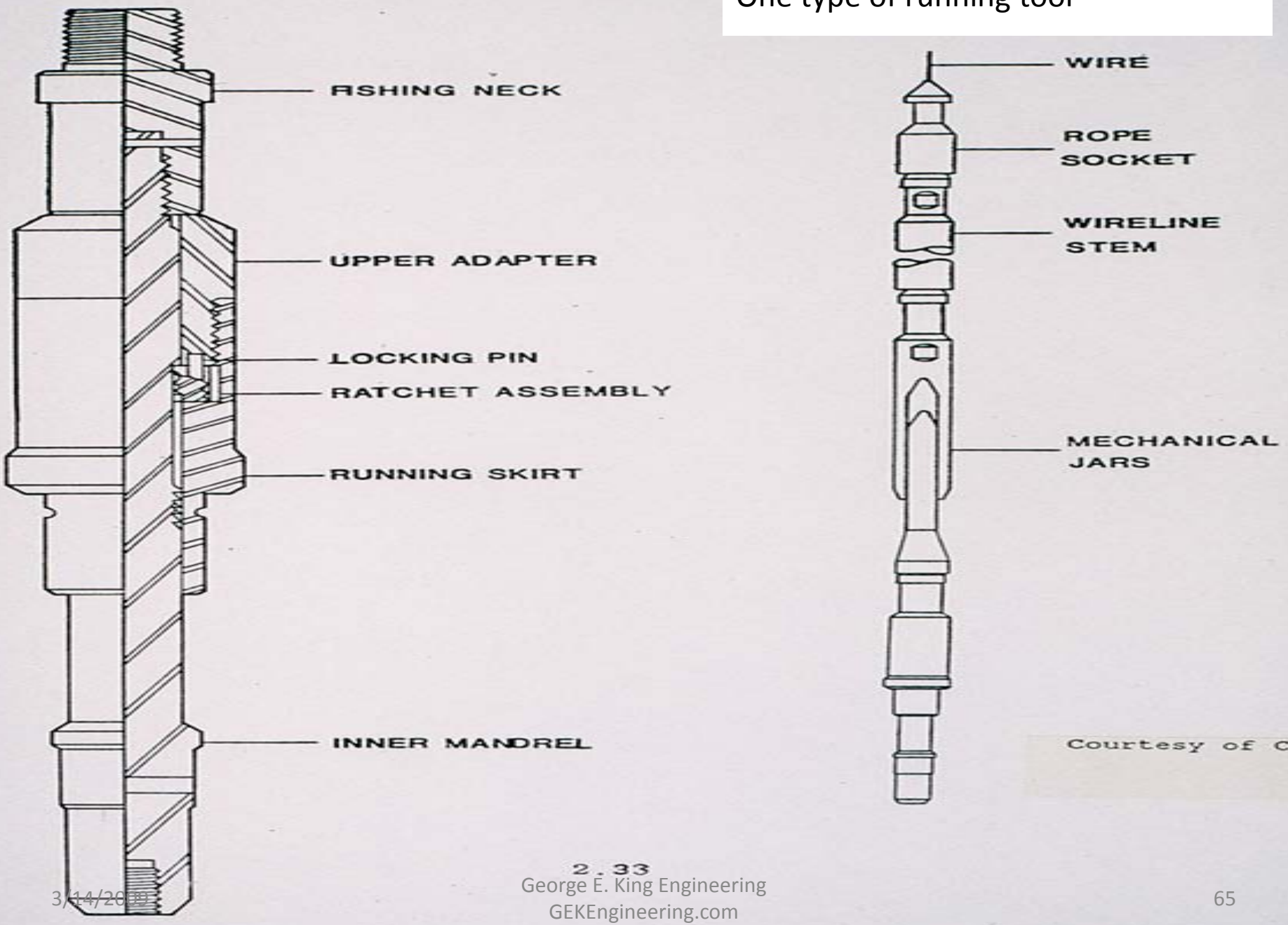
- Run a near drift block
- Set down one time and POOH
- Keep a file of paper cut-outs of pipe body diameters, connection diameters, tool connections, etc., that might look up. Helps to match the cut-out to the shape of the impression.



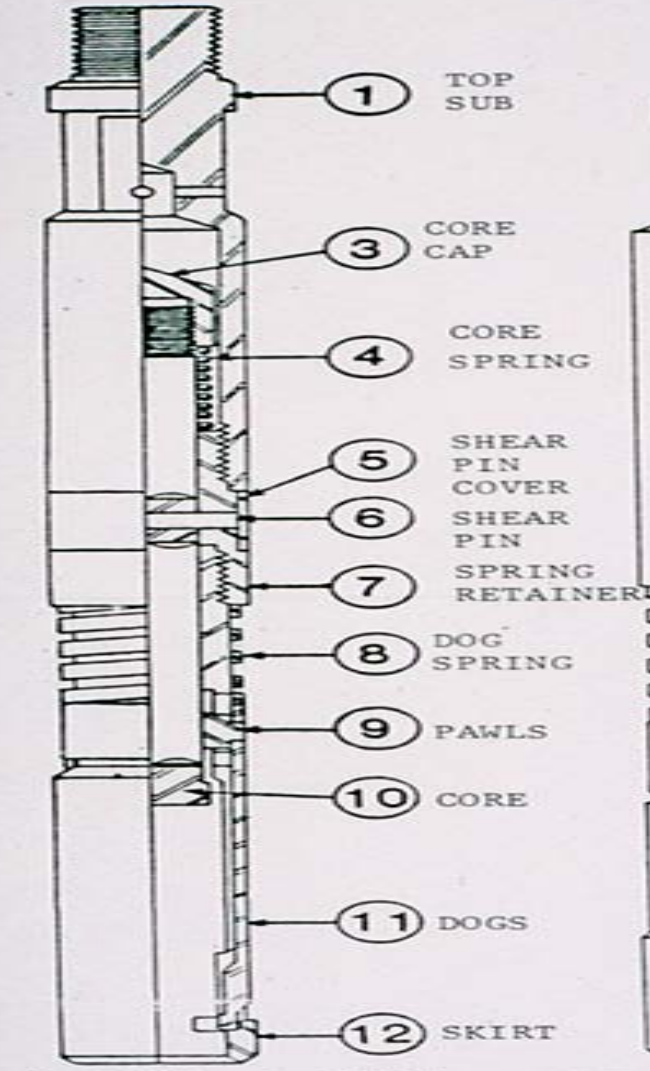
Downhole video much better than impression blocks for real information


Needle valve wedged at tubing collar
117.4 '
tubing collar

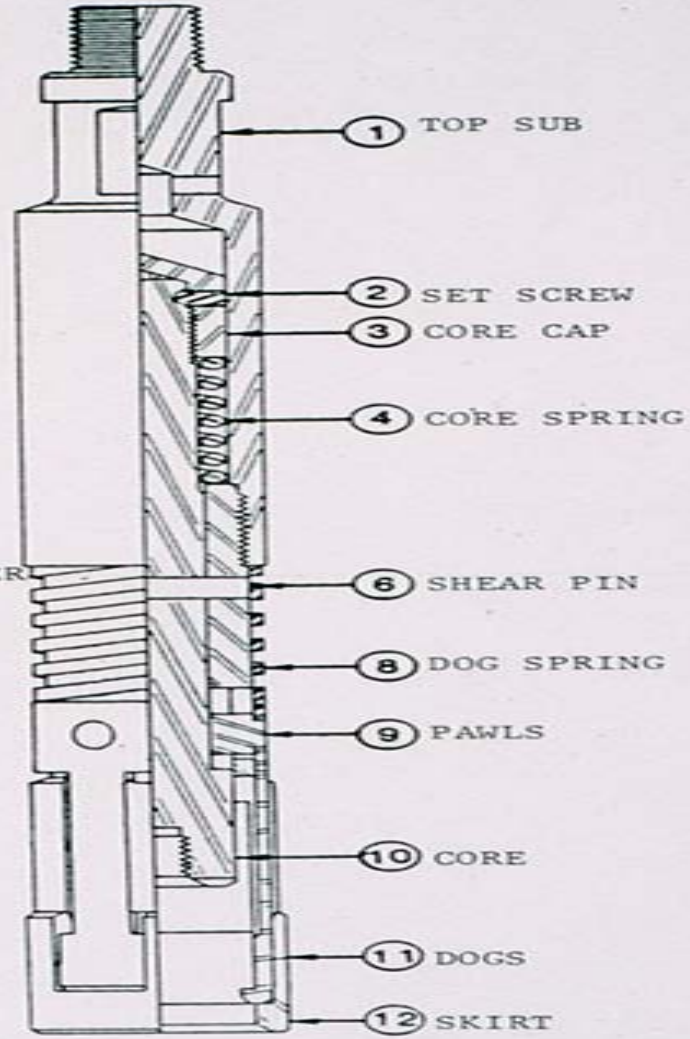
One type of running tool



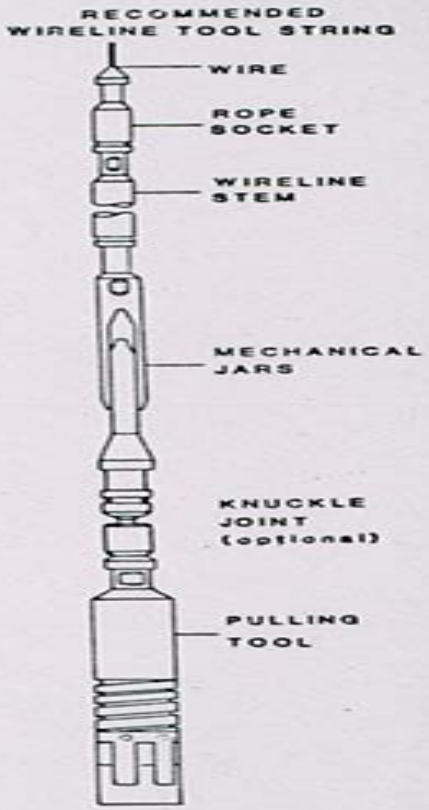
TYPE JD SERIES PULLING TOOL



1-1/4" or 1-3/8" JD PULLING TOOL



REMAINING SIZES of JD PULLING TOOLS

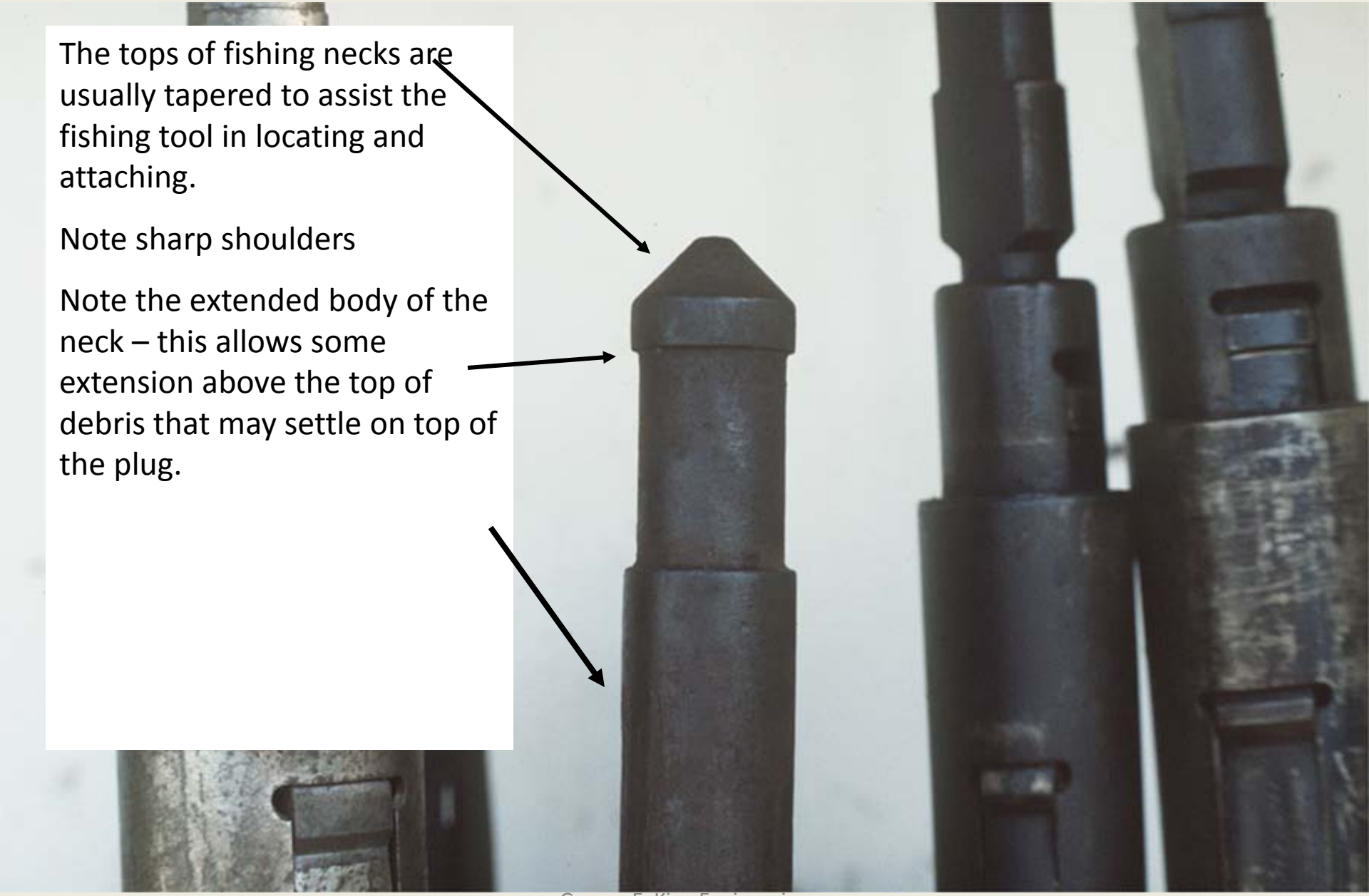


Courtesy of Camco

JD Pulling Tools – note sharp shoulders and clean tool bodies

JD Pulling tool – commonly run just below the jar in the BHA.

JD tools are used for external fishing necks.


The tops of fishing necks are usually tapered to assist the fishing tool in locating and attaching.
Note sharp shoulders
Note the extended body of the neck – this allows some extension above the top of debris that may settle on top of the plug.

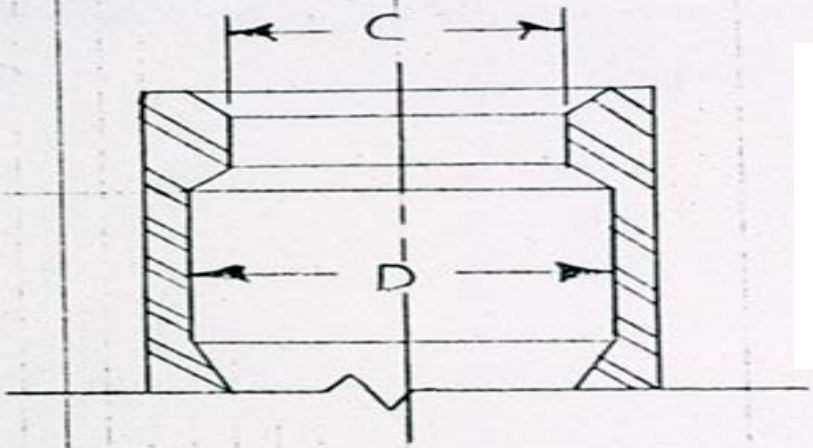
Outside fishing neck with flow through capacity.

DWG. NO.

DRAWN BY JP DATE 11/1/23 SHEET NO. _____ OF _____

CHECKED BY _____ DATE _____ JOB NO. _____

INSIDE FISHING NECK



One problem with inside fishing necks is that debris may prevent the prong from entering and latching.

A.0

SIZE	"D"	"C"
1½"	1.250	1.093
2"	1.500	1.281
2"	1.675	1.359
2½"	2.000	1.812
4"	2.125	1.875
4½"	2.500	2.250
5½"	3.062	2.781
5½"	3.250	2.718
6"	4.375	4.000

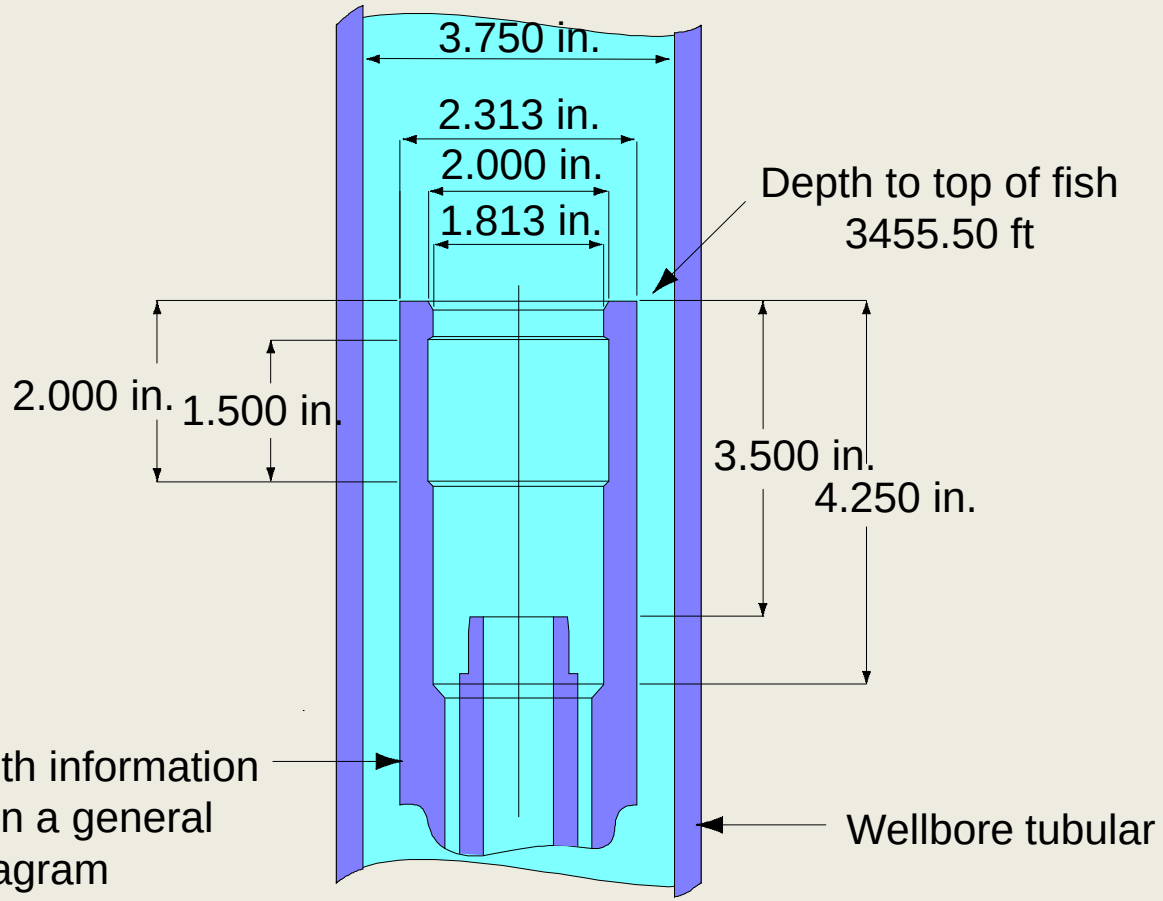
Courtesy of Camco

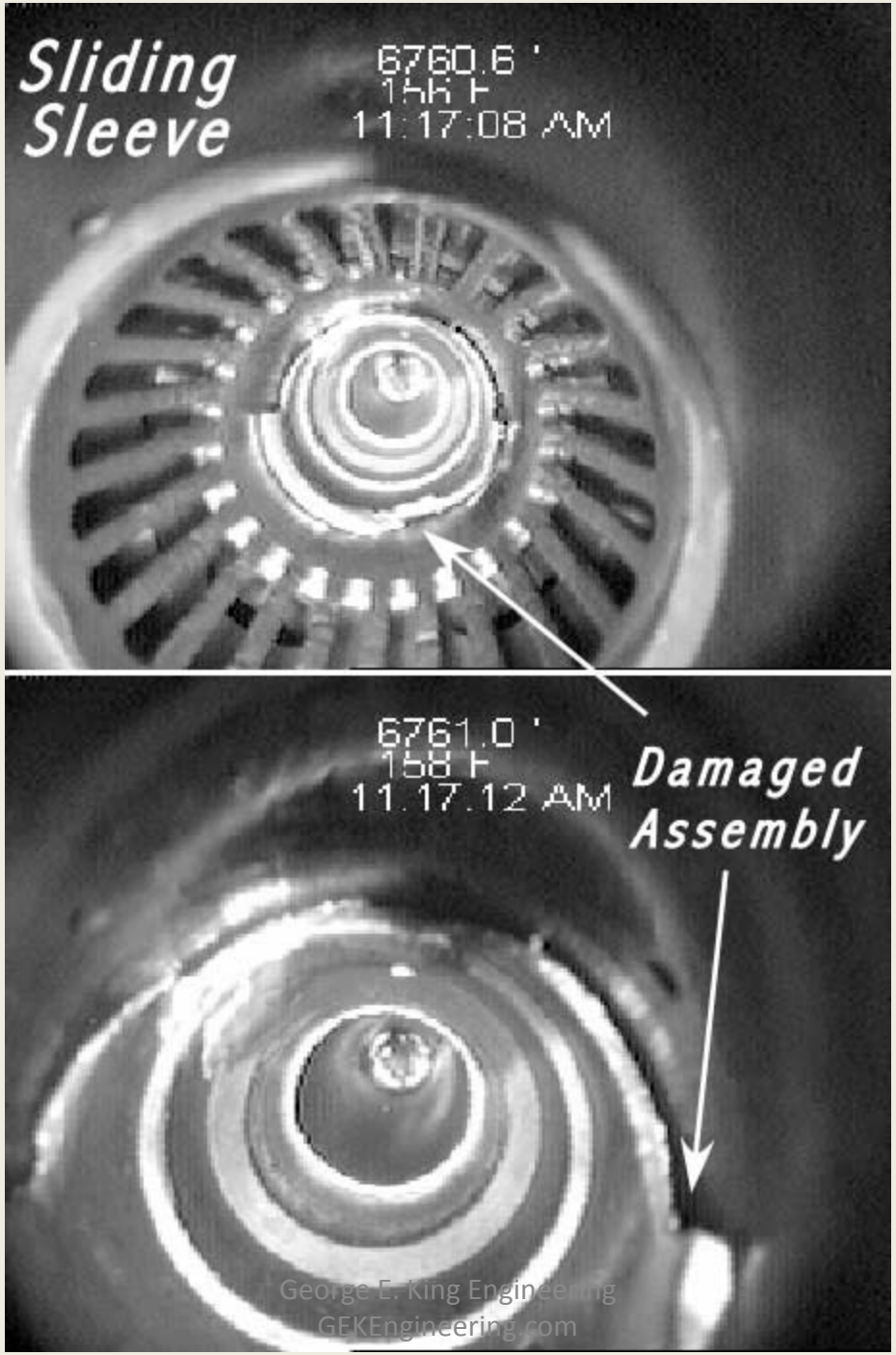
Inside fishing neck for a GS running tool

Fish Type and Dimensions

- Many fishing tools only catch on limited size range (OD or ID)
- When dimensions of fish are known:
  - Prepare accurate fishing diagram
  - Prepare wellbore or completion diagram
- Factors influencing selection of tools/techniques:
  - Fish stuck/free
  - Fill or junk on top of fish
  - Fish material properties
    - e.g. small ferrous objects retrieved by magnetic devices

Fishing Diagram - Fishing Neck Detail




Sliding Sleeve
6760.6 '
11:17:08 AM
6761.0 '
11.17.12 AM
Damaged Assembly

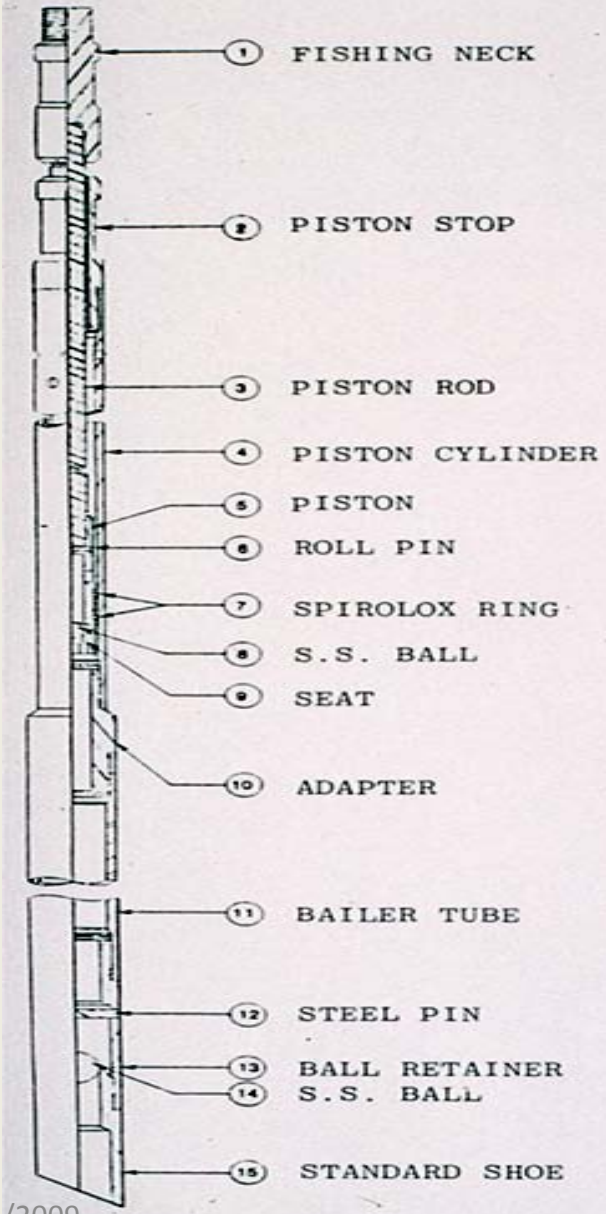
The top of a gas lift valve, bent over in the wellbore.

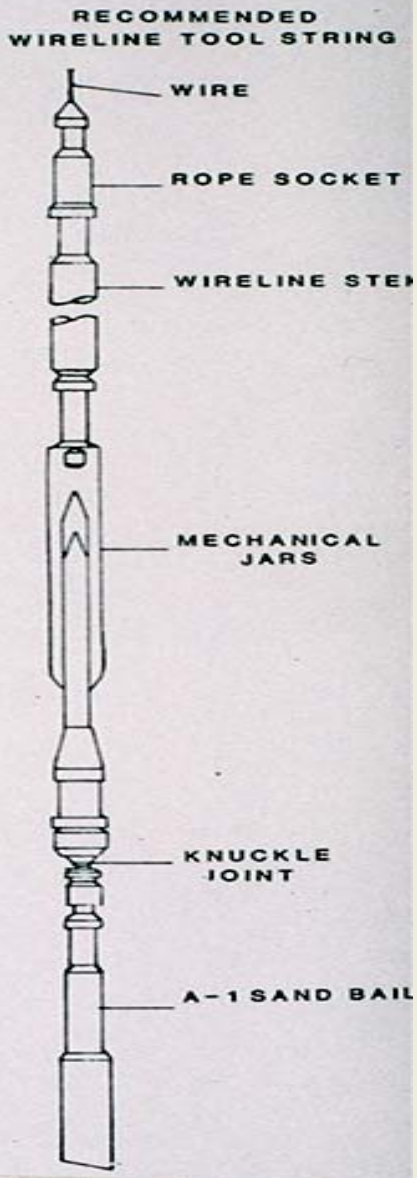
DHV Inc.

Wellbore and Completion Geometry

- Minimum tubular or restriction size
  - Determines maximum OD of CT/toolstring which can be used
- When assessing drift clearances
  - Consider removal of fill
- Pressure differential may exist across the fish
  - Can force toolstring up or down wellbore
- When determining overpull available at fish
  - Consider wellbore geometry

A-1 SAND BAILER





Courtesy of Camco

Bailer Bottom

Flapper in the bottom of the bailer tube.

Tools for running and retrieving gas lift valves – note: maximum length of tools and valve or dummy must fit into the tool body. Latching too long a valve can stick assembly.

Detent finger on tool body – indexes tool and orients for running and retrieval.

Tubing End Locator - Problem

- “Upon RIH with the tool, we encountered high pick-up weights and were unable to enter the liner and the 7" section where the finger should open up. In this scenario we began to POOH with the pin unsheared. Since the spring was forcing the finger out, it would act as a hook on any nipples/restrictions encountered while pulling out of hole. However, because of the smaller ID, the finger would be unable to push out more than approx 45 degrees and hence the shear pin would never see any force - the pivot pin would see all the stress.”

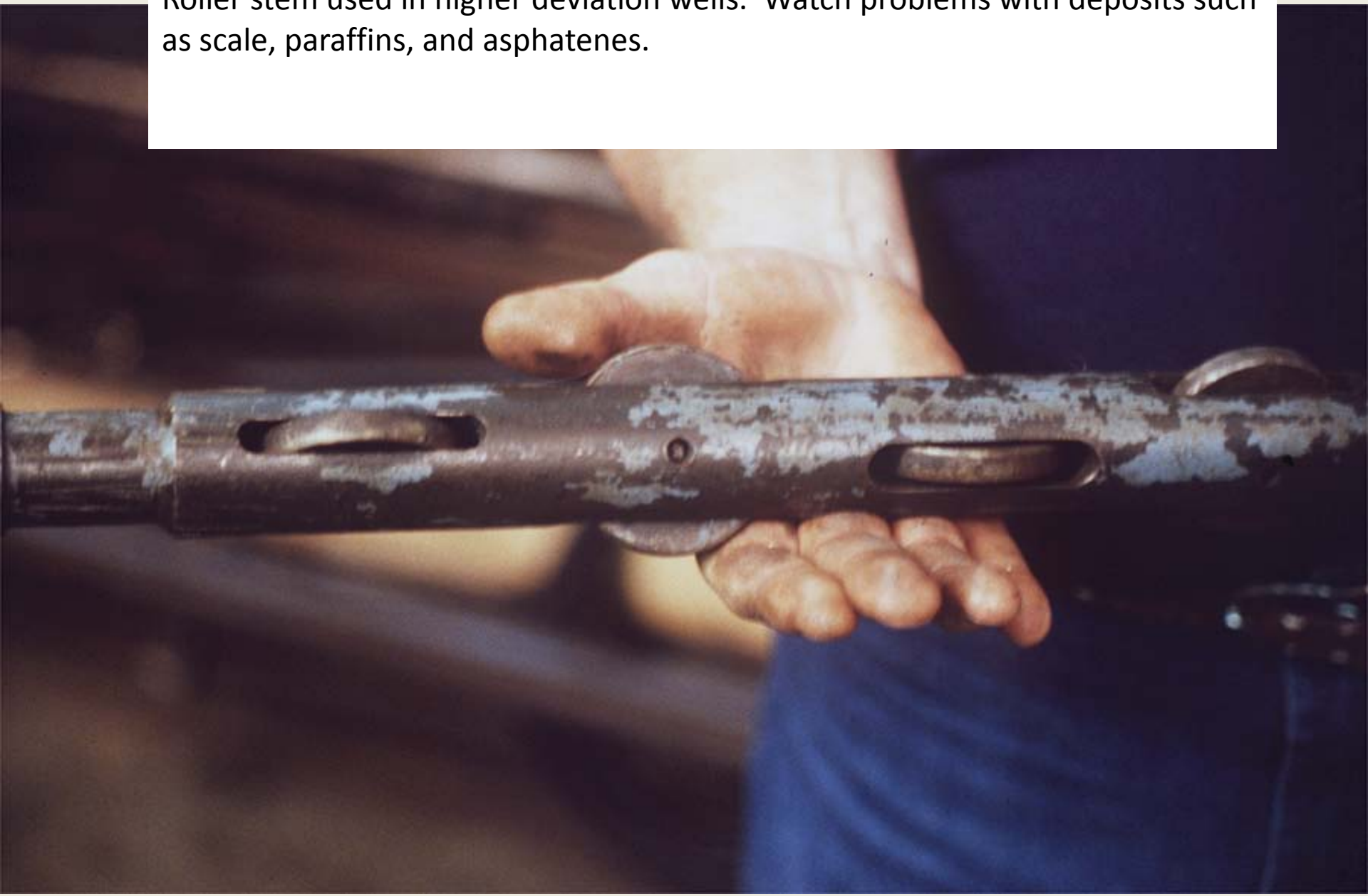
End of Tubing Locator. Arm is spring loaded and tucked into the tubing with end pointing upward. At end of tubing, the arm is deployed by the spring. It cannot swing into the slot in the body until it shears the pin.

It is normal to pin with a small pin, perhaps even steel – but watch the profiles and unusual diameter changes.

High Angle Wells

- Rollers
  - Used for getting wireline assemblies into deviated wells.
  - Most needed for heavy tool strings
  - Can increase application of wireline into wells to over 80 degrees.
- Friction Reduction
  - Chemical additives reduce friction by 30%

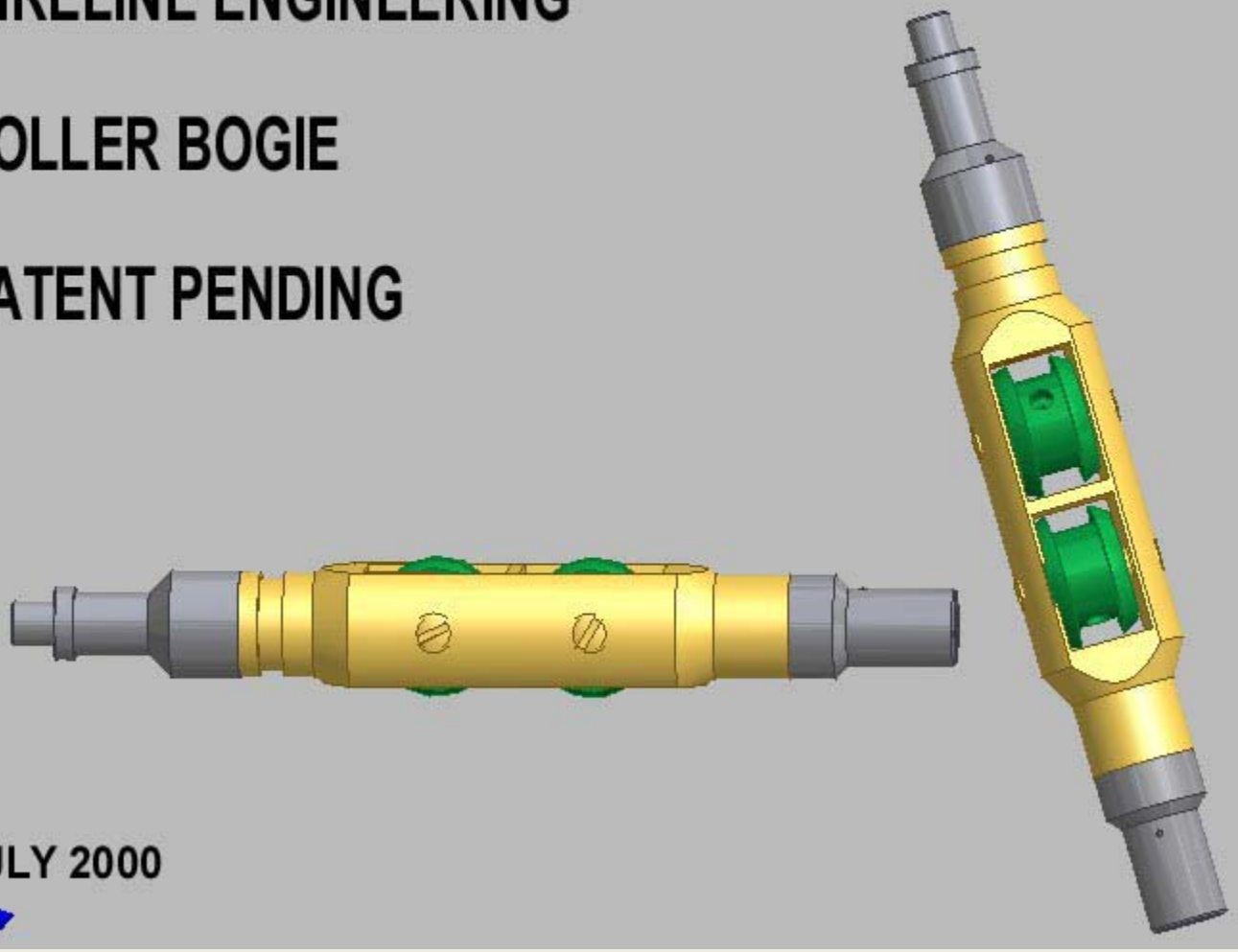
Roller stem used in higher deviation wells. Watch problems with deposits such as scale, paraffins, and asphatenes.



WIRELINE ENGINEERING

ROLLER BOGIE

PATENT PENDING



JULY 2000

Wireline Checklist – a few pointers

1. Check pipe connection connection and pressure rating of lubricator and BOP
2. Check mandrel profiles and other tools to be run for correct OD, profile type and function.
3. Check pressure equalization features on all pulling and retrieving tools
4. Check that running, pulling and fishing tools have the correct latch mechanism for the tool being run or retrieved.
5. Check wireline unit for proper function (engine, clutch and line)
6. Check wire with twist test for fatigue
7. Have emergency plan for handling breaks and leaks.